PATENT ABSTRACTS OF JAPAN

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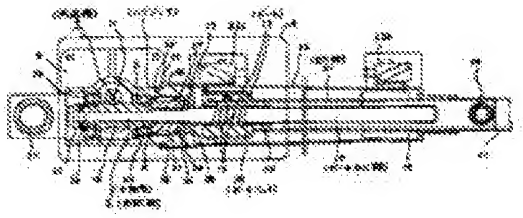
(54) MOTOR LINEAR ACTUATOR

(57)Abstract:
PURPOSE: To obtain a small-sized, lightweight motor linear actuator in which the overall length does not vary carelessly.
CONSTITUTION: A rotary shaft 2 is rotated by a motor through a reduction gear 9 and an output shaft 21 is displaced through a ball nut 18 screwed with the threaded part 17 of a ball. A roller clutch 31, a spacer 29 and a slide bearing 30 are disposed between the inner circumferential surface of the housing 1 and the outer circumferential surface of the rotary shaft 2. A frictional plate 34 is interposed between a spacer 28 rotating together with the rotary shaft 2 and the end face of the spacer 29. Thrust load in the compressive direction being applied to the spacer 29 is born by a ball bearing 3b. When the thrust load causes to rotate the rotary shaft 2, the rotary shaft 2 is locked by a roller clutch 31. When the rotary shaft is rotated by the motor and the output shaft 21 is displaced while resisting against the thrust load, the rotary shaft 2 is not locked by the roller clutch 31. Consequently, the spacer 29 rotates together with the rotary shaft 2 without causing any resistance.



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CLAIMS

[Claim(s)]
[Claim 1]Housing and the axis of rotation in which only rotation was supported free inside this housing, Reduction gears which are formed between an electric motor which was fixed to the above-mentioned housing, and in which a normal rotation inversion is free, and a driving shaft of this electric motor and the above-mentioned axis of rotation, increase and transmit torque of this driving shaft to the above-mentioned axis of rotation, A ball screw section provided in some above-mentioned axes of rotation, and a ball nut which screwed in the circumference of this ball screw section via two or more balls, and was supported free only in displacement covering shaft orientations of the above-mentioned axis of rotation, A spacer which receives thrust loading which is supported by some above-mentioned axes of rotation with this axis of rotation, enabling free rotation, and is added to this axis of rotation in an electromotive linear actuator provided with a tubed output shaft by which connect fixing was carried out to this ball nut in a base end, A while supporting rotation to this axis of rotation as free around the above-mentioned axis of rotation pipe, A one way clutch provided between a peripheral face of a pipe, and inner skin of the above-mentioned housing in the meantime, An electromotive linear actuator having been provided between a friction plate provided between an axial end side of a pipe between the above, and the above-mentioned spacer, and an axial other end surface of a pipe between the above and the above-mentioned housing, and having a bearing which supports movably thrust loading added to a between pipe from the above-mentioned axis of rotation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]The electromotive linear actuator concerning this invention is used in the state where it included, for example in various mechanical apparatus, such as an electric bed, an electric table, an electric chair, and a lifter.
[0002]
[Description of the Prior Art]For example, an electromotive linear actuator is built into the electric bed for care, and the adjusting angle etc. of the bed which put the cared person to sleep by making an electric motor into a driving source are made free. The following function of (1) and (2) is required of such an electromotive linear actuator.
(1) The function to change rotational movement of an electric motor into the axial motion of an output shaft.
(2) The function carried out as [displace / at the time of a stop of an electric motor / an output shaft].
An electromotive linear actuator which was indicated from the former to ** of the following - ** is known in order to fill this function as shown in (1) and (2).
[0003]** Izawa real work, " the ball screw and its applied technology" of the Kogyo Chosakai Publishing issue
The art about the actuator which changes rotational movement into the 134-136th page of this publication with a ball screw at a straight-line motion, and the following (a) The art of aiming at prevention from an inversion of a ball screw depending on any of - (d) they being is indicated.
(a) Give a brake action to a drive motor.
(b) Use the worm gearing which cannot be reversed for a driver.
(c) Form brake equipment in a driver axis.
(d) Use a one way clutch or a both-directions clutch.
[0004]** catalog ** JP,S63-47557,A ** JP,S50-31553,A of the linear actuator which Thompson Saginaw has published -- in the publication of these. The art about the actuator which changes rotational movement into a straight-line motion with a ball screw and other feed screws, and the art of aiming at prevention from an inversion of a feed screw by a wrapped-spring clutch are indicated.
[0005]** the art which regulates rotation of a driving shaft by the electromotive clutch and brake which are engaging and disengaging based on the energization to the art about the actuator which changes rotational movement into the publication of ******61-38892******** with a ball screw at a straight-line motion, and a solenoid is indicated.
[0006]** The art which eases the shock at the time of the return based on external load with the resistor and one way clutch which were formed the art about the actuator which changes rotational movement into the publication of ******62-63453******** with a ball screw at a straight-line motion, and in the shape of a disk is indicated.
[0007]** By giving precompression to the art about the actuator which changes rotational movement into the publication of ******62-63454******** with a ball screw at a straight-line motion, and this ball screw, resistance is added to this ball screw and the art of adjusting the speed at the time of an inversion is indicated.
[0008]

[Problem(s) to be Solved by the Invention]Each art indicated to the above-mentioned ** - ** has a problem which is described below, respectively and which should be solved.
[0009]** In the case of the indicated conventional technology, first, as shown in (a), in giving a brake action to a drive motor, the cost and weight of a drive motor increase. As shown in (b), in using the worm gearing which cannot be reversed for a driver, unless it makes the lead angle of a worm gearing small, positive prevention from an inversion cannot be aimed at. On the other hand, if a lead angle is made small, engagement efficiency worsens, and in order to secure sufficient working speed, it will be necessary to use the large-sized electric motor which rotates at high speed. In the case of the structure which forms brake equipment in a driver axis, or uses a one way clutch or a both-directions clutch for it as shown in (d) as shown in (c), If it tries to aim at sufficient prevention from an inversion independently, a large-sized thing must be used as these brake equipments or a clutch, and the whole device will be enlarged.
[0010]In the case of the conventional technology indicated to ******, in the case of these, When displacing an output shaft via a feed screw mechanism with an electric motor, in order for a wrapped-spring clutch to serve as some resistance and to acquire a positive inversion preventive effect it not only to to reduce efficiency, but, a fairly large-sized thing must be used as a wrapped-spring clutch.
[0011]** In order to use expensive parts in this case in the case of the indicated conventional technology, it is not avoided that the whole device becomes expensive -- the control circuit which makes it an electric motor interlocked with and the linear actuator itself not only becomes expensive, but controls an electromotive clutch and brake is needed.
[0012]** In the case of the indicated conventional technology, the installing space of the resistor formed in the shape of a disk and a one way clutch increases in this case, and the whole device is enlarged. And since it aims at the shock relaxation at the time of a return, a positive inversion preventive effect cannot be acquired.
[0013]** In the case of the indicated conventional technology, in this case, even if it can adjust the speed at the time of an inversion, it is impossible to aim at sufficient prevention from an inversion.
The electromotive linear actuator of this invention is invented that each of such inconvenience should be canceled.
[0014]
[Means for Solving the Problem]An electromotive linear actuator of this invention is provided with the following.
It is housing like an electromotive linear actuator known from the former.
The axis of rotation in which only rotation was supported free inside this housing.
An electric motor which was fixed to the above-mentioned housing and in which a normal rotation inversion is free.
Reduction gears which are formed between a driving shaft of this electric motor, and the above-mentioned axis of rotation, increase and transmit torque of this driving shaft to the above-mentioned axis of rotation, A ball screw section provided in some above-mentioned axes of rotation, a ball nut which screwed in the circumference of this ball screw section via two or more balls, and was supported free only in displacement covering shaft orientations of the above-mentioned axis of rotation, and a tubed output shaft by which connect fixing was carried out to this ball nut in a base end.

[0015]Especially in an electromotive linear actuator of this invention, A spacer which receives thrust loading which is supported by some above-mentioned axes of rotation with this axis of rotation, enabling free rotation, and is added to this axis of rotation, A while supporting rotation to this axis of rotation as free around the above-mentioned axis of rotation pipe, A one way clutch provided between a peripheral face of a pipe, and inner skin of the above-mentioned housing in the meantime, It is provided between a friction plate provided between an axial end side of a pipe between the above, and the above-mentioned spacer, and an axial other end surface of a pipe between the above and the above-mentioned housing, and has a bearing which supports movably thrust loading added to a between pipe from the above-mentioned axis of rotation.
[0016]
[Function]The electromotive linear actuator of this invention constituted as mentioned above is

used in the state where thrust loading is added to an output shaft. By acting as follows, based on the hand of cut of the driving shaft of an electric motor, the electromotive linear actuator of this invention covers shaft orientations, and displaces an output shaft in the state where it was attached to this appearance.

[0017] First, the driving shaft of the above-mentioned electric motor is rotated normally, and the above-mentioned output shaft is explained about the operation at the time of resisting the above-mentioned thrust loading and making it displaced. In this case, the between pipe can rotate freely to housing, without the axis's of rotation rotating to a determined direction via reduction gears, and locking a one way clutch. Therefore, in this state, a between pipe, a friction plate, and a spacer rotate with the axis of rotation, and existence of these each member is not resisting to rotation of this axis of rotation. As a result, the above-mentioned axis of rotation rotates smoothly to a determined direction with normal rotation of the above-mentioned driving shaft. And the ball nut screwed in the ball screw section of this axis of rotation is displaced to shaft orientations, the above-mentioned thrust loading is resisted and the above-mentioned output shaft is displaced. Under the present circumstances, existence of a reverse rotation preventing mechanism is not resisting to displacing an output shaft.

[0018] Next, where the above-mentioned driving shaft is stopped, based on the above-mentioned thrust loading, it becomes a tendency which the above-mentioned axis of rotation rotates to a counter direction with the above-mentioned determined direction from an output shaft with the power in which it is added to a ball screw section via a ball nut and two or more balls. The pipe between the above serves as this axis of rotation and a tendency rotated in the direction simultaneously. The above-mentioned one way clutch locks and the pipe between the above stops as a result, rotating to housing. In this state, in order to rotate the above-mentioned axis of rotation, it is necessary to let the side and the companion face of the above-mentioned friction plate slide. Therefore, the above-mentioned axis of rotation can be prevented from rotating based on the above-mentioned thrust loading by regulating the coefficient of friction between the side of these friction plates, and a companion face to the desired value which can be defined in design.

[0019] Where the above-mentioned driving shaft is reversed, in addition to the torque added to the above-mentioned axis of rotation based on the above-mentioned thrust loading, the torque transmitted via reduction gears from the above-mentioned driving shaft is added to the above-mentioned counter direction. Therefore, the above-mentioned driving shaft resists the frictional force which acts between the side of the above-mentioned friction plate, and a companion face, and rotates. Under the present circumstances, since this frictional force serves as resistance to rotation of the above-mentioned driving shaft, rotation of this driving shaft is prevented from being performed rapidly.

[0020]

[Example] Drawing 1 - 5 show the first working example of this invention. The electromotive linear actuator of this example is attached to the portion to which thrust loading of a compression direction is added at the time of the use. The housing 1 is built by carrying out dies casting shaping of the aluminum alloy, for example. Inside this housing 1, only rotation is supporting the base end (left edge part of drawing 1) of the axis of rotation 2 free with one pair of ball bearings 3a and 3b whose each is deep groove types. The ball bearing 3a drawing 1 - on the left-hand side of two supports only a radial road movably among these one pairs of ball bearings 3a and 3b. On the other hand, the ball bearing 3b on the right-hand side of [the] a figure also supports movably thrust loading of the above-mentioned compression direction besides a radial road. For this reason, the shaft-orientations end face (drawing 1 - two left end sides) of the outer ring of spiral wound gasket 4 which constitutes the ball bearing 3b of the above-mentioned right-hand side is dashed against the snap ring 5 attached firmly to the inner skin of the above-mentioned housing 1. Therefore, in the case of this example, the ball bearing 3b of this right-hand side is equivalent to the bearing (anti-friction bearing) which supports thrust loading movably.

[0021] The electric motor 7 in which a normal rotation inversion is free is fixed to the mounting flange 6 formed in the lateral surface of the above-mentioned housing 1. And the driving shaft 8 of this electric motor 7 is inserted into the above-mentioned housing 1. The reduction gears 9 are formed between this driving shaft 8 and the above-mentioned axis of rotation 2, it increases and the transfer of the torque of this driving shaft 8 to the above-mentioned axis of rotation 2 is enabled. In the case of working example of a graphic display, the worm reducer is used as these

reduction gears 9. For this reason, externally fitting and fixing of the worm gear 10 is carried out to the end part of the above-mentioned axis of rotation 2. In working example of the graphic display, prevention from rotation of the worm gear 10 to the above-mentioned axis of rotation 2 is aimed at by forming in a part of peripheral face of these axes of rotation 2, and a part of inner skin of the worm gear 10 the flat face engaged mutually.

[0022] In the above-mentioned housing 1, only rotation supports warm ones 11 free in the direction of a twist to the above-mentioned axis of rotation 2 with one pair of ball bearings 12a and 12b, and warm one 11 of this and the above-mentioned worm gear 10 are meshed. The outer periphery part of the flat spring 14 was dashed against the outer ring of spiral wound gasket 13 from which while it is a deep groove type constitutes the ball bearing 12a, and precompression is given to the above-mentioned worm 11 and the one above-mentioned pair of ball bearings 12a and 12b. Therefore, there is no shakiness in this engage part. The end face of the stud 15 screwed in the screw-thread hole formed in the wall of the above-mentioned housing 1 is dashed against the center section of the above-mentioned flat spring 14, and regulation of the above-mentioned precompression is enabled. 16 is a lock nut. The notching 41 covering [in the apical surface of the above-mentioned driving shaft 8] a diametral direction for the protruded piece 40 covering a diametral direction is formed in the end face side (drawing 3 - four right end surfaces) of the above-mentioned worm 11, respectively. And the transfer of rotation of the above-mentioned driving shaft 8 to warm ones 11 is enabled by making these protruded pieces 40 and the notching 41 engaged.

[0023] On the other hand, the portion except the base end of said axis of rotation 2 is used with the ball screw section 17, when a section forms the spiral slot on the circular arc shape. And the ball nut 18 is made to screw in the circumference of this ball screw section 17 via two or more balls 19 and 19. And screwing immobilization of the base end of the output shaft 21 cylindrical to the joint cylinder part 20 formed in the tip part (drawing 1 - two right end sections) of this ball nut 18 is carried out. The circumference of the above-mentioned ball nut 18 and the output shaft 21 is covered with the taper cylinder-like covering 22. The above-mentioned output shaft 21 and the ball nut 18 are combining the tip part of this output shaft 21 with a predetermined part, and prevention from rotation is achieved. Therefore, in the state, the above-mentioned ball nut 18 is supported free only in the displacement covering the shaft orientations of this axis of rotation 2 around the above-mentioned axis of rotation 2 at the time of attachment of an electromotive linear actuator.

[0024] The limit switches 23a and 23b are formed in the base end and tip part of the above-mentioned covering 22, respectively, and it responds to the position of the above-mentioned ball nut 18, and which limit switches 23a and 23b turn on, and he is trying to turn off. That is, the above-mentioned ball nut 18 moves to the base end of the ball screw section 17, and the limit switch 23a formed in the base end is turned on and turned off where the electromotive linear actuator has been shrunken. On the other hand, the above-mentioned ball nut 18 moves to the tip part of the ball screw section 17, and the limit switch 23b formed in the tip part is turned on and turned off where the electromotive linear actuator has been extended. The energization to said electric motor 7 is controlled based on the detecting signal of these each limit switches 23a and 23b. That is, it prevents energizing in the direction further developed from the state where energized in the direction further shrunk from the state where the electromotive linear actuator had been shrunken, or it had been extended. The above-mentioned covering 22 is being built with a synthetic resin or metal, and stopping to the concave 25 the projected rim 24 formed in the base end inner skin having been formed to the peripheral face of said housing 1, and also binding tight with the band 26, and connect fixing is carried out to the above-mentioned housing 1.

[0025] This ball screw section 17 side forms the step 27 used as a major diameter in the end face portion of the above-mentioned ball screw section 17 at said some of axes of rotation 2. And the one side (drawing 1 - two right laterals) inner circumference slippage portion of the spacer 28 of being heavy-gage and a round ring form is dashed against this step 27. Therefore, compression thrust loading added to the above-mentioned axis of rotation 2 drawing 1 - leftward [of two] is transmitted to the above-mentioned spacer 28. The internal circumference edge of this spacer 28 has fitted into the peripheral face of the above-mentioned axis of rotation 2 by interference fit, or has fitted in by un-circular peripheral surfaces. Therefore, the above-mentioned spacer 28 rotates with the above-mentioned axis of rotation 2.

[0026]Into the portion between the installed part of said worm gear 10, and the base ends of the above-mentioned ball screw section 17, the pipe 29 between the shape of a thick cylinder is supported via the plain bearing 30 at some above-mentioned axes of rotation 2, enabling free rotation. And the roller clutch 31 which is a kind of a one way clutch is formed between the peripheral face of the pipe 29, and the inner skin of said housing 1 in the meantime. That is, inner fitting immobilization of the outer ring of spiral wound gasket 32 which made inner skin the cam surface is carried out at the above-mentioned housing 1, and it is carrying out as [rotate / this outer ring of spiral wound gasket 32 / to the housing 1]. And two or more rollers 33 and 33 are formed between the inner skin of this outer ring of spiral wound gasket 32, and the peripheral face of the pipe 29 between the above. These each rollers 33 and 33 are elastically pressed by circumferencial direction one way as everyone knows with the spring formed between the cages which omitted the graphic display, and not rotating. Therefore, rotation of the pipe 29 is permitted in the meantime, without each above-mentioned rollers 33 and 33 eating into the above-mentioned cam surface, when the pipe 29 between the above rotates to a determined direction. When the pipe 29 between the above rotates to an opposite direction, each above-mentioned rollers 33 and 33 eat into the above-mentioned cam surface, and the pipe 29 between the above stops on the other hand, rotating by the inside of the housing 1.
[0027]The friction plate 34 is pinched between the axial end side (drawing 1 - two right end surfaces) of the pipe 29 between the above, and the above-mentioned spacer 28. At least, this friction plate 34 is built with material with a big coefficient of friction, and carries out friction engagement of the both side surfaces with one side of said spacer 28 which is a companion face, and the end face of the pipe 29 between the above. However, in order to make a friction engagement state regularity, after the spacer 28 and the between pipe 29 have carried out relative rotating, one of friction engaging surfaces slides (relative displacement), and it is carrying out as [carry out / the friction engaging surface of the other / a relative displacement]. working example of a graphic display -- the friction surface product of one side of the spacer 28, and one side of the friction plate 34 -- this friction plate 34 -- on the other hand -- by making it larger than a friction surface product with the end face of the between pipe 29. the friction plate 34 -- on the other hand -- even when the end face of the between pipe 29 slides, it is carrying out as [carry out / one side of the spacer 28 and one side of the friction plate 34 / a relative displacement]. Therefore, one side of the spacer 28 and one side of the friction plate 34 may be pasted up.
[0028]In the case of working example of a graphic display, the belleville spring 36 is formed between the nut 35 screwed on the base end of said axis of rotation 2, and the inner ring of spiral wound gasket of said ball bearing 3a, said worm gear 10 is turned to the center section of the above-mentioned axis of rotation 2, and it is pressing elastically. This is adjusting the crevice between composition each members of said reduction gears 9, or amending the crevice based on wear, and is for reducing the operating sound of the reduction gears 9.
[0029]The electromotive linear actuator of this invention constituted as mentioned above supports pivotably the displacement side fitting part 38 which formed in the fixed axis the fixed side fitting part 37 formed in the base end (left edge part of drawing 1) of said housing 1, for example at the tip part (right end section of drawing 1) of said output shaft 21 in a displacement shaft, respectively. Since this displacement shaft serves as a tendency displaced in the direction approaching the above-mentioned fixed axis, the electromotive linear actuator of this example is used in the state where thrust loading of a compression direction is added to the above-mentioned output shaft 21. By acting as follows, based on the hand of cut of the driving shaft 8 of the electric motor 7, the electromotive linear actuator of this invention covers shaft orientations, and displaces the above-mentioned output shaft 21 in the state where it was attached to this appearance.
[0030]First, the driving shaft 8 of the above-mentioned electric motor 7 is rotated normally, and it explains about the operation at the time of expanding an electromotive actuator by resisting the above-mentioned thrust loading and displacing the above-mentioned output shaft 21. In this case, the axis of rotation 2 rotates to a determined direction via the reduction gears 9, and the roller clutch 31 can rotate the between pipe 29 freely to the housing 1, without locking. Therefore, in this state, the between pipe 29, the friction plate 34, and the spacer 28 rotate with the axis of rotation 2, and existence of these each members 29, 34, and 28 is not resisting to rotation of this

axis of rotation 2. The roller clutch 31 acts like roller bearing, and permits rotation of the pipe 29 between the above. Therefore, existence of the roller clutch 31 which is a one way clutch is not resisting to rotation of the axis of rotation 2.

[0031] As a result, the above-mentioned axis of rotation 2 rotates smoothly to a determined direction with normal rotation of the above-mentioned driving shaft 8. And the ball nut 18 screwed in the ball screw section 17 of this axis of rotation 2 is displaced to shaft orientations (drawing 1 - the right direction of two), the above-mentioned thrust loading is resisted and the above-mentioned output shaft 21 is displaced. Under the present circumstances, resistance does not become to existence with the pipe 29 between the above, the friction plate 34, the spacer 28, and the roller clutch 31 which constitute a reverse rotation preventing mechanism displacing the output shaft 21 as mentioned above. Therefore, the driving force of the above-mentioned electric motor 7 is used effective in displacing the above-mentioned output shaft 21. As a result, even if a large-sized thing is not used in particular as the electric motor 7 or it does not enlarge the moderating ratio (increase ratio of torque) of the reduction gears 9, an electromotive linear actuator can fully be expanded. As it following-**, the reduction gears 9 do not necessarily need to be the structure which cannot be reversed. Therefore, even when using a worm reducer like this example, engagement efficiency can be raised by enlarging the lead angle of a worm gearing, and sufficient working speed can be secured with the small electric motor 7.

[0032] Next, where the above-mentioned driving shaft 8 is stopped, based on the above-mentioned thrust loading, it becomes a tendency which the above-mentioned axis of rotation 2 rotates to a counter direction with the above-mentioned determined direction from the output shaft 21 with the power in which it is added to the ball screw section 17 via the ball nut 18 and two or more balls 19 and 19. The pipe 29 between the above serves as this axis of rotation 2 and a tendency rotated in the direction simultaneously. The above-mentioned roller clutch 31 locks and the pipe 29 between the above stops as a result, rotating to the housing 1. In this state, in order to rotate the above-mentioned axis of rotation 2, it is necessary to let the side of the above-mentioned friction plate 34, and the end face of the pipe 29 between the above which is a companion face slide. Therefore, the above-mentioned axis of rotation 2 can be prevented from rotating based on the above-mentioned thrust loading by regulating the coefficient of friction between the side of these friction plates 34, and the end face of the between pipe 29 to the desired value which can be defined in design.

[0033] The torque which is transmitted to the above-mentioned axis of rotation 2 via the reduction gears 9 from the above-mentioned driving shaft 8 in addition to the torque added based on the above-mentioned thrust loading where the above-mentioned driving shaft 8 is reversed is added to the above-mentioned counter direction. Therefore, the above-mentioned driving shaft 8 resists the frictional force which acts between the side of the above-mentioned friction plate 34, and the end face of the between pipe 29, and rotates. Under the present circumstances, since this frictional force serves as resistance to rotation of the above-mentioned driving shaft 8, rotation of this driving shaft 8 is prevented from being performed rapidly. Therefore, if the coefficient of friction between the side of the above-mentioned friction plate 34 and the end face of the between pipe 29 and driving torque of the electric motor 7 are made into an appropriate value, the small electric motor 7 can be made to perform smoothly not only extension of an electromotive linear actuator but contraction.

[0034] Next, drawing 5 explains about the setting method of the coefficient of friction between the side of the above-mentioned friction plate 34, and the end face of the between pipe 29. The meaning of the numerals used by the following explanation is as follows, respectively. The reduction gears 9 presupposed that the grade which contributes to the prevention from an inversion is ignored (it will assume, if there is no inversion preventing function in the reduction gears 9).

F : thrust-loading mu added to the output shaft 21 in a compression direction : Coefficient of friction D between the side of the friction plate 34, and the end face of the between pipe 29 : Average diameter L of the contact portion of the side of the friction plate 34, and the end face of the between pipe 29 : Lead T of a ball screw : An electromotive linear actuator. In order to make it elongate, operation torque T' which should be added to the axis of rotation 2 : Torque T_b added to the axis of rotation 2 based on thrust loading of compression direction : braking torque eta: based on friction between the side of the friction plate 34, and the end face of the between pipe 29 - -

transmission- efficiency eta' of the ball screw at the time of normal rotation of the driving shaft 8: . The transmission efficiency of the ball screw at the time of the inversion of the driving shaft 8
[0035]
T=(F- L)/(2 and pi- eta) - - - (1)
Come out, and it is and is T'=(F- L- eta')/(2andpi). - - - (2)
Come out, and it is and is T_b=(micro- F- D) / 2. - - - (3)
It comes out. It is T_b>T' in order not to shorten the overall length of an electromotive linear actuator according to thrust loading at the time of the energization stop to the electric motor 7. - - - (4)
It comes out and there is a certain necessity. In order for driving torque to make the smallest possible thing usable as the electric motor 7, it is preferred to make driving torque required of the driving shaft 8 when shrinking the overall length of an electromotive linear actuator below into the driving torque required of the driving shaft 8 when making it elongate. The driving torque required of the driving shaft 8 at the time of contraction of an electromotive linear actuator is proportional to (T_b- T'). Therefore, T>= (T_b- T') - - - (5)
It comes out and a certain thing is preferred. (4) It is T+T'>=T_b>T' when (5) types are summarized. - - - (6)
It becomes. When the aforementioned (1) - (3) type is substituted for this (6) type, they are - (L/pi- D) {eta'+(1/eta)} >=mu> (L- eta') / (pi- D).
- - - (7)
For example, in the case of the electromotive linear actuator built into an electric bed, L** 5 mm, D** 20 mm, and an about [eta**eta'**0.9] thing are built. When this condition is substituted for the above- mentioned (7) formula, it is 0.16>=mu>0.07. - - - (8)
It can expand and contract using a small electric motor, and by carrying out shows that the electromotive linear actuator which moreover is not contracted at the time of the deenergization to an electric motor can be constituted.
[0036] Next, drawing 6 shows the second working example of this invention. In this example as well as the case of the first working example mentioned above, it is used for the portion to which thrust loading of a compression direction is added. The ball bearing 12b which is a bearing which supports movably thrust loading added to this axis of rotation 2 among one pair of ball bearings 12a and 12b which support the axis of rotation 2 movably in the case of this example is formed between the end face (left end of drawing 6) portion of this axis of rotation 2, and the housing 1. The inner ring of spiral wound gasket 39 and the worm gear 10 which constitute another ball bearing 12a are made to intervene between the spacer 28 and the friction plate 34 which receive the above- mentioned thrust loading. Thrust loading of the compression direction added to the above- mentioned axis of rotation 2 is transmitted to the above- mentioned friction plate 34 via the inner ring of spiral wound gasket 39 and the worm gear 10 from the above- mentioned spacer 28, and carries out friction engagement of the one side (left surface of drawing 6) of this friction plate 34, and the end face of the between pipe 29. Other composition and operations are the same as that of the first working example mentioned above almost.
[0037] Next, drawing 7 shows the third working example of this invention. In this example as well as the case of the first working example mentioned above and the second working example mentioned above, it is used for the portion to which thrust loading of a compression direction is added. In the case of this example, the thrust needle bearing 42 is used as a bearing which supports the above- mentioned thrust loading movably. And the roller clutch 31 which is a one way clutch is made to have a function as a radial needle bearing. For this reason, in this example, the above- mentioned thrust needle bearing 42 is formed between the steps 44 which formed the extroversion flange 43 in the outer- periphery- of- end side of the between pipe 29, and were formed in the one side (left lateral of drawing 7) of this extroversion flange 43, and the inner surface of the housing 1. The friction plate 34 is pinched between the other sides (right lateral of drawing 7) of the above- mentioned extroversion flange 43, and the spacer 28. Other composition and operations are the same as that of the first - the second working example almost.
[0038] Next, drawing 8 shows the fourth working example of this invention. In the case of this example, it is used for the portion to which thrust loading of the direction of hauling is added. For this reason, in the case of this example, the thrust ball bearing 46 is formed between the flange 45

formed in the tip part (right end section of drawing 8) inner skin of the housing 1, and the apical surface (right end surface of drawing 8) of the between pipe 29. And the friction plate 34 is pinched between the spacers 28 which carried out externally fitting and fixing to the end face side (left end side of drawing 8) and the axis of rotation 2 of the pipe 29 between the above. Thrust loading added in the direction of hauling to the axis of rotation 2 is added to the above-mentioned spacer 28 via the nut 35, the back plate 47, and the worm gear 10 which were screwed on the base end of this axis of rotation 2. The composition and the operation except having changed the direction which the roller clutch 31 locks in connection with thrust loading having changed in the direction of hauling from the compression direction (it was made to lock when it became a tendency which the axis of rotation 2 rotates according to thrust loading of the direction of hauling), It is the same as that of the first working example mentioned above almost.

[0039]Next, drawing 9 - 10 show the fifth working example of this invention. Also in this example, it is used for the portion to which thrust loading of the direction of hauling is added. For this reason, in the case of this example, one pair of friction plates 34 and 34 and the between pipe 29 are formed between the nut 35 and the helical gear 55 which were screwed on the base end (left edge part of drawing 9) of the axis of rotation 2. And the both-ends side of the between pipe 29 is made to carry out friction engagement of the medial surface of these one pairs of friction plates 34 and 34, and the end face of the above-mentioned helical gear 55 and one side of the back plate 47 are made to carry out friction engagement of the lateral surface of each friction plates 34 and 34.

[0040]In the case of this example, he rotates the middle worm gear 48 by warm ones 11 fixed to the driving shaft 8 of the electric motor 7, and is trying to rotate the above-mentioned helical gear 55 by this middle worm gear 48 to it. With constituting in this appearance, the above-mentioned driving shaft 8 and the axis of rotation 2 can be arranged in parallel.

[0041]The hexagonal prism part 49 is formed in the portion projected from the above-mentioned nut 35 in the base end of the above-mentioned axis of rotation 2. And the through-hole 50 is formed in the portion which counters this hexagonal prism part 49 at some housing 1. The lid 52 as shown in drawing 10 is fitted in the circular hole 51 formed in the pars intermedia of this through-hole 50 in the state of intersecting perpendicularly with this through-hole 50, enabling free rotation. Usually, sometimes, the direction of the breakthrough 53 and the above-mentioned through-hole 50 which continued and formed this lid 52 in the diametral direction at this lid 52 by making it rotate 90 degrees from the state which shows in drawing 9 is changed 90 degrees, and, sometimes, the above-mentioned through-hole 50 is plugged up. Therefore, a foreign matter does not usually sometimes advance into the housing 1 through this through-hole 50. On the other hand, when it becomes impossible to rotate the axis of rotation 2 with the electric motor 7, the time of interruption to service, etc. As shown in drawing 9, the breakthrough 53 and the above-mentioned through-hole 50 are coincided, and the tip part of the handle 54 is inserted into the above-mentioned housing 1 through these both the holes 53 and 50, and Ko Rokkaku and the above-mentioned hexagonal prism part 49 which were formed in the tip part of this handle 54 are made to fit in. And the above-mentioned axis of rotation 2 is rotated, and an electromotive actuator is made to expand and contract by operating the above-mentioned handle 54.

[0042]When expanding an electromotive linear actuator with the electric motor 7 at the time of usual, and the roller clutch 31 locks, the between pipe 29 does not rotate but said one pair of friction plates 34 and 34 and the end face of the between pipe 29 carry out friction engagement according to thrust loading of said direction of hauling. Then, an electromotive linear actuator can be smoothly expanded by resisting the brake force based on frictional force, and rotating the above-mentioned axis of rotation 2 with the above-mentioned electric motor 7. In the case of this example, two friction surfaces exist, and the above-mentioned thrust loading is added to each friction surface, respectively. Therefore, 1/2 of the brake force to need may be sufficient as the brake force generated in each friction surface. When shrinking an electromotive linear actuator with the electric motor 7, the between pipe 29 rotates without the roller clutch 31 locking. Therefore, the above-mentioned above-mentioned electromotive linear actuator can be contracted smoothly, without receiving the resistance based on existence of a brake mechanism.

[0043]Next, drawing 11 shows the sixth working example of this invention. This example is used for compression, hauling, and the portion to which thrust loading of both directions may be added. For this reason, in the case of this example, it has formed the spacers 28a and 28b, the between pipes 29a and 29b, the roller clutches 31a and 31b, and 2 sets of friction plates 34a and 34b at a time,

respectively. The hand of cut for making both the roller clutches 31a and 31b lock is mutually reverse. That is, in the state where one roller clutch 31a (31b) locks, rotation of the roller clutch 31b (31a) of another side is attained. The ball bearing 12c supports movably thrust loading of both directions besides a radial road.

[0044]the spacer [on the other hand / when thrust loading of a compression direction is added in the case of this example constituted by this appearance / (right direction of drawing 11)] 28a, the between pipe 29a, and the roller clutch 31a -- it acts like the first working example that the friction plate 34a mentioned above. On the other hand, when thrust loading is added in the direction of hauling, it acts like the fourth working example that the spacer 28b of another side (left of drawing 11), the between pipe 29b, the roller clutch 31b, and the friction plate 34b mentioned above. Since a both- ends side carries out friction engagement of the between pipe 29b with a companion face, the sum total of frictional force which acts on these both sides may be sufficient as the brake force over thrust loading of the direction of hauling. When rotating the axis of rotation 2 with the electric motor 7 in the case of this example, which roller clutch 31a (31b) certainly locks. However, even if the roller clutch 31a (31b) corresponding to the pipe 29a (29b) locks while not receiving thrust loading, the between pipe 29a (29b) concerned rotates by light power to the axis of rotation 2 or the worm gear 10. Therefore, the driving torque required when rotating the axis of rotation 2 with the electric motor 7 does not almost become large.

[0045]Next, drawing 12 shows the seventh working example of this invention. In the case of this example, the ball bearing 12c for supporting thrust loading movably arranged in the center is inserted, The spacer 28a and the worm gear 10 were formed in axial both sides, and it has formed the between pipes 29a and 29b, the roller clutches 31a and 31b, and 2 sets of friction plates 34a and 34b at a time among these both the members 28a and 10. According to the direction of thrust loading, which between pipe 29a (29b), the roller clutch 31a (31b), and the friction plate 34a (34b) carry out a brake action like the case of the sixth working example that was mentioned above also in this example, An electromotive linear actuator prevents expanding and contracting carelessly.

[0046]

[Effect of the Invention]Since this invention is constituted as it was stated above, and it acts, it is small and lightweight and, moreover, an electromotive linear actuator with little power consumption can be provided cheaply.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The sectional view showing the first working example of this invention.
[Drawing 2]The A section enlarged drawing of drawing 1.
[Drawing 3]The B-B sectional view of drawing 2.
[Drawing 4]The figure which looked at the bond part of a worm and a driving shaft from the upper part of drawing 3.
[Drawing 5]The C section enlarged drawing of drawing 2.
[Drawing 6]The important section sectional view showing the second working example of this invention.
[Drawing 7]The important section sectional view showing the third working example.
[Drawing 8]The important section sectional view showing the fourth working example.
[Drawing 9]The important section sectional view showing the fifth working example.
[Drawing 10]The perspective view of the lid used for the fifth working example.
[Drawing 11]The important section sectional view showing the sixth working example of this invention.
[Drawing 12]The important section sectional view showing the seventh working example.
[Description of Notations]
1 Housing
2 Axis of rotation
3a and 3b Ball bearing
4 Outer ring of spiral wound gasket
5 Snap ring
6 Mounting flange
7 Electric motor
8 Driving shaft
9 Reduction gears
10 Worm gear
11 Worm
12a, 12b, and 12c Ball bearing
13 Outer ring of spiral wound gasket
14 Flat spring
15 Stud
16 Lock nut
17 Ball screw section
18 Ball nut
19 Ball
20 Joint cylinder part
21 Output shaft
22 Covering
23a and 23b Limit switch
24 Projected rim
25 Concave
26 Band

27 Step
28, 28a, and 28b Spacer
29, 29a, and 29b Between pipe
30 Plain bearing
31, 31a, and 31b Roller clutch
32 Outer ring of spiral wound gasket
33 Roller
34, 34a, 34b friction plate
35 Nut
36 Belleville spring
37 Fixed side fitting part
38 Displacement side fitting part
39 Inner ring of spiral wound gasket
40 Protruded piece
41 Notching
42 Thrust needle bearing
43 Extroversion flange
44 Step
45 Flange
46 Thrust ball bearing
47 Back plate
48 Middle worm gear
49 Hexagonal prism part
50 Through- hole
51 Circular hole
52 Lid
53 Breakthrough
54 Handle
55 Helical gear

[Translation done.]